

PRE SERVICE TEACHERS' ABILITY TO NAME NESTING ANIMALS IN ECOSYSTEMS – A PERSPECTIVE OF BIODIVERSITY

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Abstract

This study investigated the consciousness of the pre service teachers of nesting animals in certain ecosystems. The study group included primary school and subject teacher students. The students were asked to name 10 different nesting animal species in each ecosystem drawing. Spruce dominated coniferous forest got the highest number of animals mentioned by ST students. The lowest mean of the named animals was in the fen by PT students. Pre service teachers mentioned mammals more often than other animals like birds, reptiles & amphibians & fish or invertebrates. ST students named more birds than PT students, and ST students were able to name more animals at the species level. In many of the answers only mammals were included only mammals in the savannah. Usually 4 animals were named to the tropical rainforest. The most common nesting animals in the answers were mammals like lion, giraffe, zebra, hyena and antelope in the savannah. The biggest variety of nesting animal groups was in the fen where the most common named animals were elk, mosquito, frog, crane and capercaillie. The named animals were the same than in an earlier study, where the students were asked to name animals living and moving in the ecosystems. This indicates that certain animals are remembered, commonly known, and will therefore be named. This study reveals that the consciousness of taxonomy is limited and should be improved. Consciousness of animals is important for future teachers to be able to teach biodiversity and sustainable development.

Key words: biodiversity, consciousness, ecosystem, nesting animal, pre service teachers

Introduction

The loss of biodiversity is a major focus of concern of the environment worldwide and has become a challenging educational topic (Gaston & Spicer, 2004; van Weelie & Wals, 2002). Researchers agree that retaining biological diversity is an important key factor for sustainable development (Gayford, 2000; Lindemann-Matthies, 2002, 2006; Lindemann-Matthies & Bose, 2008; Marton-Lefevre, 2010) and every citizen is supposed to act for sustainable future. Biodiversity is threatened by the changes of land use in different ecosystems, devastation of the living environment, overuse of natural resources, pollution and climate change as well as introduced non native species and invaders with their diseases and parasites (Gilg et al., 2009; von Herten et al., 2011; Walls, 1999). Preserving biodiversity has been an important issue during the last ten years, especially during The International Decennial of The Biodiversity 2005-2014. Pre service teachers and their future pupils are key persons promoting sustainable development and its education.

The concepts of species knowledge, species diversity, biodiversity and sustainable development are strongly related to each other. Biodiversity can be defined in many ways. In biology a central measure is the number of species of the living organisms, but also the genetic variation and ecosystem diversity are important factors (Gayford, 2000; Lindemann-Matthies, 2002, 2006; Lindemann-Matthies & Bose, 2008; Marton-Lefevre, 2010;). The entity of biological diversity also comprises ecological and evolutionary processes (e.g. gene flow). However one the most common entities used are the species (van Weelie & Wals, 2002), which especially are the targets of different conservation efforts. Therefore at the back of this study is the fact, that the bigger is the number of named animals, animal species or animal groups, the larger is the biodiversity. In this study the consciousness of biodiversity is investigated via pre service teachers' knowledge of the fauna and its relation to the ecosystem where the animals nest.

There are several matters affecting one's ability to remember or identify animals – like one's attitudes towards them. The researchers have shown that people have attitudes to certain animals like spectacular species ivory-billed woodpecker (Dalton, 2005), charismatic dolphins (Barney et al., 2005), “disgusting” animals like bats and spiders (Prokop & Tunnicliffe, 2008), animals people have fear for (Prokop & Fancovicova; 2010, Rakison, 2009) or animals that are popular (ladybird beetle, rabbit, squirrel) or unpopular (potato beetle pest, predator wolf, disease carrying mouse) (Prokop & Tunnicliffe, 2010). The names of animals are remembered better, if one has a relation to them, which can be either positive or negative. However, the relationship between (environmental) attitude and knowledge is not fully understood and it is complex (Zimmerman, 1996.)

According to Tunnicliffe and Reiss (1999) animals are often identified according to their anatomical features like attractive colors, whereas the knowledge of the living environment has not been used as identification fact. In other words, when people identify animals they do not often use the information of animals' surrounding nature, ecosystem or habitat where they live, breed and nest, thus the connection between the animals and the ecosystem/biodiversity is interrupted. In this case the identifier has deficient ability of environmental literacy. According to the study of Tunnicliffe and Reiss (1999) the older students had better ability of the environmental literacy, while they used more the information of the habitat of the animals than the younger ones.

There are several biodiversity related issues, which are or can be crucial from the point of view of knowledge about the environment, ecosystems and their function (Trombulak et al., 2004). The teachers are important promoters for delivering the consciousness of the biodiversity. The related issues are, e.g. success of breeding, nesting and production of the offspring. Biodiversity in a certain area is related also to the microbiota (von Hertzen et al., 2011). Changes in the microbiota affect diversity of the plant and animal populations in the ecosystems. To avoid these changes the

researchers, teachers and municipals are the key persons to deliver biodiversity knowledge and educate citizens of the sustainable future.

Animals living and nesting in the Finnish or in exotic ecosystems are studied and taught in Finnish Kindergarten, in Basic Education, in Upper Secondary Schools (the Finnish National Core Curricula (NCC) for Basic Education 2004; NCC for Upper Secondary school 2003) and in the primary school teacher education studies at the University, and to larger extent in the studies of biology subject teachers. Not only identification of the animals (species) and their relation to the nesting ecosystem but also endangered, threatened, vulnerable, near extinct species are in focus. At school also anatomy and physiology but less the behavior of animals is studied.

In this study the pre service teachers' consciousness of animals in relation to the ecosystem the animals nest, is in focus.

Study design

The aim of the study and the study questions

In our earlier study we asked the pre service teachers to name living and moving animals in four ecosystems (Yli-Panula & Matikainen, 2011, 2013). Most often mammals were named to all four ecosystems. However, breeding and nesting of the animals are among the most important factors to retain the biodiversity in an ecosystem. This is why this study ended up to investigate the nesting animals, and further the consciousness of the primary school teacher students (PT) and subject teacher students (ST) of nesting animals in four ecosystems, and further their consciousness of biodiversity of various ecosystems.

Hypothesis was that by asking students to name *nesting* animals they would more likely name birds and other animals than mammals than by asking just to name living animals.

Four of the study questions were designed to study pre service teachers' "animal knowledge" (A) and the 5th study question (B) to give background data like information sources of knowledge, teachers' basic knowledge and the reliability of the study. The "animal knowledge" in this study means the knowledge of the pre service teachers of animals classified to taxa higher than species level (genus, family & higher taxa) contrary to "species knowledge".

A) Study questions of the animal knowledge

- 1) What is the mean number of nesting animals, which the PT and ST students were able to mention out of the ten asked? Is there any statistical difference in the number of named nesting animals between these two study groups?
- 2) How many different animals were named per ecosystem by PT and ST students?

- 3) How many of the animals groups (MAM=mammals, BIR=birds, RAF=reptiles & amphibians & fish, INV=invertebrates) were mentioned by PT and ST students at the species, genus or family & higher taxonomic level?
- 4) What were the most commonly mentioned names of species, genus or family by ecosystem?
- B) Study questions of the background knowledge
- 5) Where did the pre service teachers get their information? Did the asked information belong to basic knowledge and were the questions asked clear for them?

Material and methods

This survey is part of the bigger project and has both a quantitative and a qualitative approach. Study included two various groups of pre service teachers (n=232) in southwestern Finland. The study groups were a) the primary school teacher students (PT, n=181), who studied their first year pedagogical studies and b) subject teacher students (ST, n=50), who were specialized in biology and geography and attended their first and the only study year of pedagogical studies. The ST students had already studied a minimum 2 years of biology and geography at the university.

A questionnaire including drawings of four ecosystems, Finnish spruce dominated coniferous forest (SCF), fen (FEN), rainforest (TRF) and savannah (SAV) were used. The SCF was visually illustrated by a middle-aged coniferous forest. FEN was depicted as a drawing of few coniferous trees and a typical field layer (Fig. 1). The layers of TRF were clearly indicated, and tree savannah was depicted in the picture of the savannah.

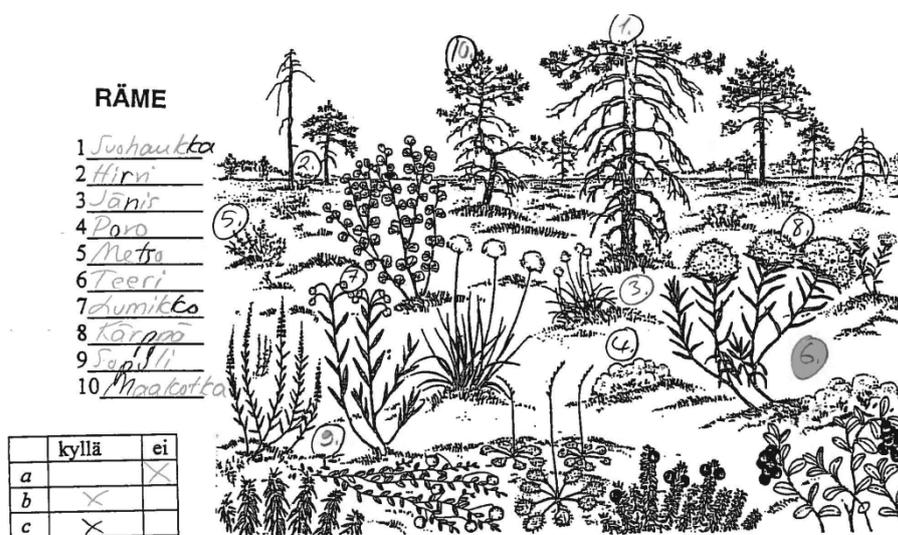


Figure 1. Picture of the Finnish FEN (räme) as an example of the four studied ecosystems. Teacher students were asked to mention 10 animal species which are

nesting in this environment. (Image modified from Nyberg & Lehtiö, 1997, Koulun biologia, Metsät ja suot, opettajan opas)

The students were asked to name 10 different nesting animal species in each of the ecosystem drawings (maximum number of names were 40), and mark the nest of the animal in a correct place in the drawing (results of the nesting place are not shown here). In the questionnaire the students were also asked where did they get this information from? They were also asked to indicate the two most important choices. The alternatives were; school (including school books), home, hobbies, media, other (what?). They were further asked whether the questions were clear and did the asked knowledge belong to the basic knowledge what the teachers need when they are teaching. At the end some PT students left empty answers (2 in SCF, 11 in fen and 2 in TRF), but there were no empty questionnaires among ST students.

During the analysis the number of nesting animals was calculated and the falsely named animals were excluded. To the group of the nesting animals were accepted not only birds which have a nest or nest ants, but also animals like a hare which give birth in the middle of the bush or a lion, which hides the puppies while hunting and similar animals. The calculations were done according to the taxa (species, genus, family & higher) of the animal as well as according to the animal groups (MAM=mammals, BIR=birds, RAF=reptiles & amphibians & fish, INV=invertebrates).

Wilcoxon non-parametric test (Crawley, 2007) was used to count statistical significances of species knowledge and animal knowledge of pre service teachers. In this study animal knowledge means all those animals named in higher taxa than species level.

Results

How many nesting animals per ecosystem the pre service teachers were able to mention out of the ten asked?

ST students (n=50) were able to mention 1646 animals and PT students (n=181) named 5457 animals. ST student were able to name more animals both at species level ("species knowledge") and at the higher taxonomic level ("animal knowledge") than PT students (Table 1). The mean number of the animals named by the ST students was significantly higher than the animal number of the PT students. ST students had the highest mean number of named animals in all ecosystems and the highest mean ($x=9,8$) was in spruce dominated coniferous forest. The lowest mean ($x=5,9$) was named to FEN by PT students.

Table 1. Mean number of animals named by primary school teacher students (PT; n=181) and subject teacher students (ST; n=50) in four ecosystems (SCF= spruce dominated coniferous forest, FEN= Finnish fen, SAV= savannah and TRF = tropical rainforest). Animal knowledge = animals named at higher taxa than species level, species knowledge = animals named in species level. The number of the empty answers was 2 in SCF, 11 in fen and 2 in TRF among PT students

	Animal knowledge			Species knowledge		
	PT students	ST students	p	PT students	ST students	p
Mean	30,9	34,9	< 0,0001	16,2	21,8	< 0,0001
SCF	9,3	9,8	< 0,001	6,8	8,6	< 0,0001
FEN	5,9	7,3	< 0,01	3,6	5,6	< 0,0001
TRF	7,3	8,6	< 0,0001	1,9	2,8	< 0,001
SAV	8,5	9,2	< 0,001	3,9	4,7	< 0,001

The mean value in species knowledge was lowest for TRF by both study groups, and the mean value for PT students was significantly lower compared to ST students. The biggest difference in the mean values between the two study groups was in the species knowledge of the Finnish FEN and SCF. At the species level the animals were named most often into the SCF ecosystem compared to other ecosystems. There was a significant difference in species knowledge between the two study groups especially dealing with the FEN. ST students named species the second best to FEN while the second best mean of species knowledge for PT students was SAV.

How many different animals per ecosystem did PT and ST students name?

The total number of various animal names for FEN and TRF was about the same (130 various animals) in both study groups, although the group of PT students (n=181) was more than 3 times bigger than the group of ST students (n=50) (Fig. 2). Although PT students named about 20 different animals more for SCF and SAV than ST students the mean number of mentioned animal names per student was significantly higher by ST students.

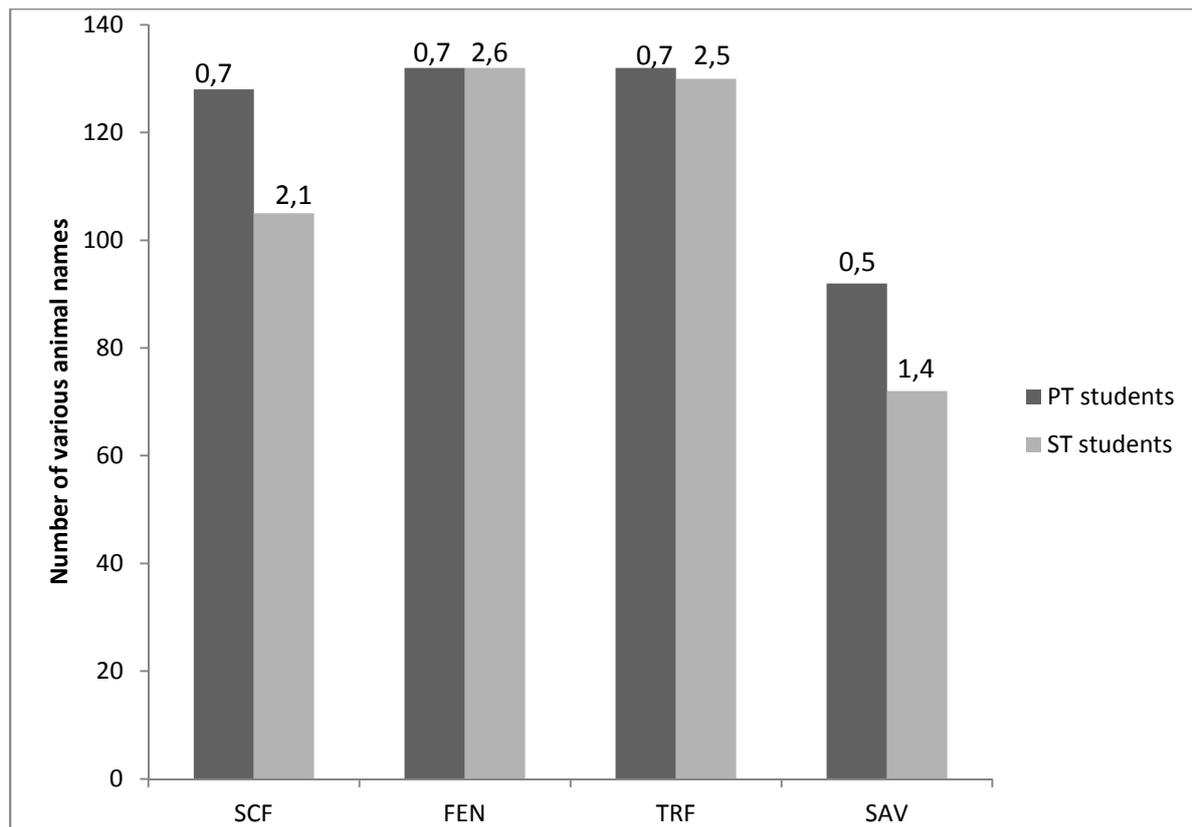


Figure 2. The total number of different animals named to the four ecosystem drawings (SCF= spruce dominated coniferous forest, FEN= Finnish fen, SAV= savannah and TRF = tropical rainforest) by pre service teachers (PT = primary school teacher students (n=181), ST= subject teacher students (n=50)). Figures on the top of the columns indicate the mean values of the various animal names, mentioned by a single student.

The mean number of various animal names mentioned by a single student varied from 1,4 -2,5 among ST students and 0,5 - 0,7 among PT students. The biggest mean 2,6 was found in the various animal names of FEN, mentioned by ST students. The variation in the number of animal names was largest in the answers of ST students.

How many of the animal groups were mentioned by primary school teacher students (PT) and subject students (ST) at the species, genus or family & higher taxonomic level? The animal groups studied were mammals (MAM), birds (BIR), reptiles & amphibians & fish (RAF) and invertebrates (INV) (Fig. 3). The pre service teachers most often mentioned mammals (PT 60 %, ST 55%) of the four animal groups (MAM, BIR, RAF, INV) in their answers. ST students (26 %) named more birds than

PT students (19 %). Both study groups named about the same amount of animals in RAF and INV.

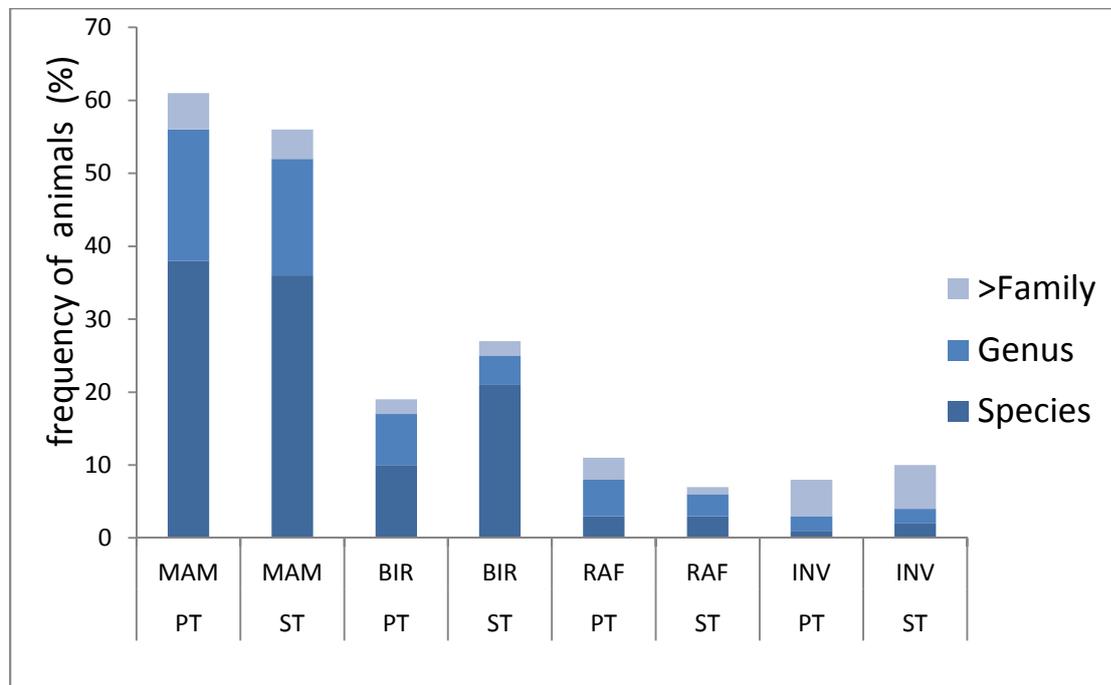


Figure 3. The various taxa (species, genus, family or higher taxa) of nesting animals named by primary school teacher (PT, n=181) and by subject teacher (ST, n=50) students. Nesting animals were divided in four categories (MAM = mammals, BIR = birds, RAF = reptiles & amphibians & fish, INV = invertebrates)

The higher taxa than species were common in the answers, although the students were asked to name animal species. PT students were able to mention 52 % of animals and ST students 60% of all animals at the species level.

How many animal groups of the 5 vertebrate classes and invertebrates (just one group) did PT and ST teacher students mention?

The named animals were grouped in five vertebrate classes; mammals, birds, reptiles, amphibians and fish and one group including only invertebrates formed just one group. When counting animal groups per student's answers and per ecosystems, the following results were found. PT students most often named 3 animal groups in SCF, FEN and TRF ecosystems (Fig. 4). Both PT and ST students named the greatest variety of animal groups to TRF where 2 of the students gave answers with 5 animal groups. Nobody named six animal groups in her/his answer.

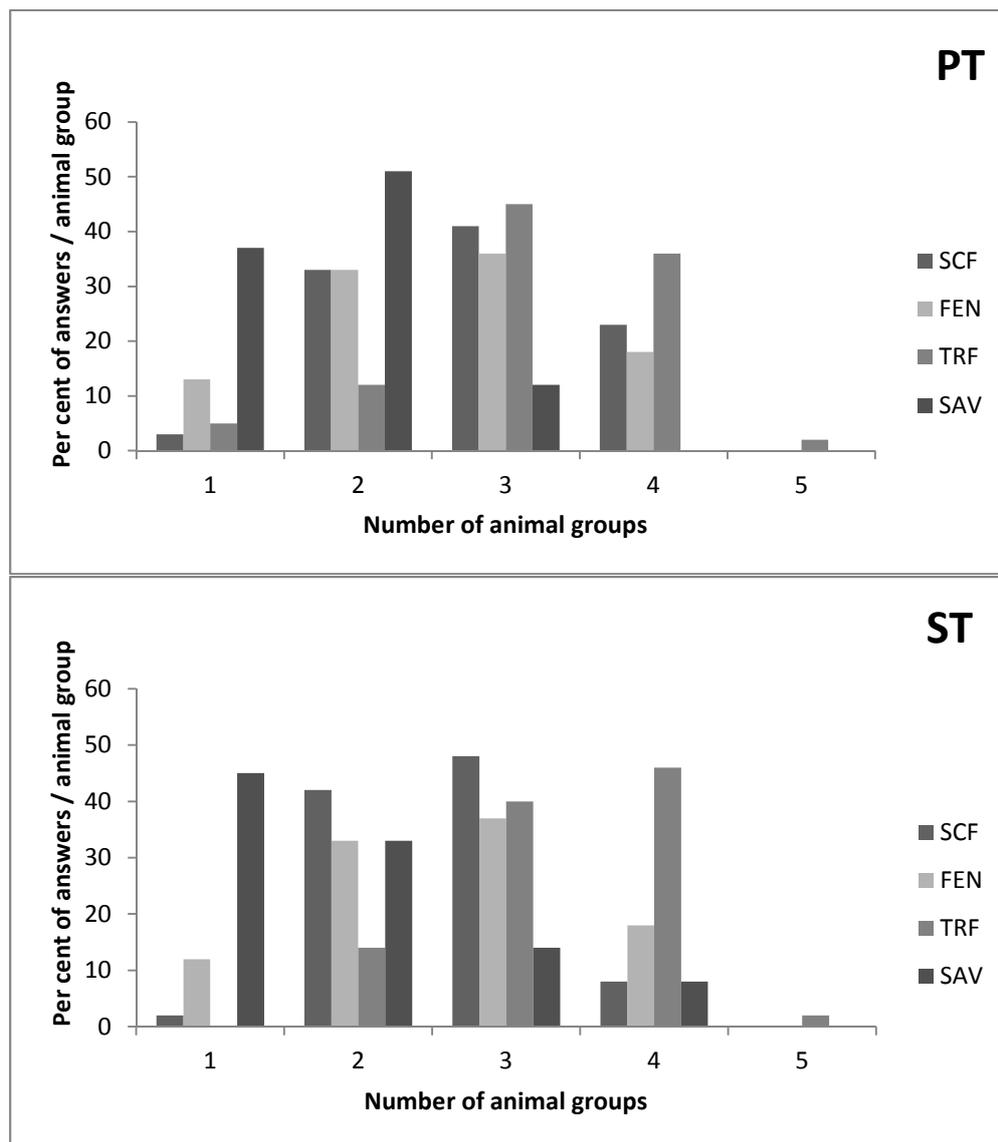


Figure 4. The per cent of answers of the primary school teacher students (PT, n=181) and subject teacher students (ST, n=50). The named animals per answer of each student were divided in six categories (mammals, birds, reptiles, amphibian, fish, invertebrates). The percentage of answers are shown per all studied ecosystems (SCF= spruce dominated coniferous forest, FEN= Finnish fen, TRF = tropical rainforest and SAV= savannah). Numbers on the horizontal scale shows the reached frequency of animal groups of each student (e.g. 1 = only one animal group was mentioned by student, nobody named 6 groups.)

The variety in animal names was smallest in SAV, usually only 1 or 2 animal groups were named. No answers of PT students reached 4 animal groups in SAV, however many ST students had mentioned 4 animal groups in SAV. ST students also more often than PT students named 4 animal groups in TRF and contrary to PT students gave no answers with only 1 animal group in TRF.

What were the most commonly mentioned names of species, genus or family by ecosystem?

The five most often mentioned animals by PT students were mammals in SCF and SAV ecosystems (Fig. 5). In SCF the red squirrel got the highest frequency and in SAV the lion, which had the highest frequency of all named animals in the answers of PT students. In TRF it was gorilla and in the FEN the elk.

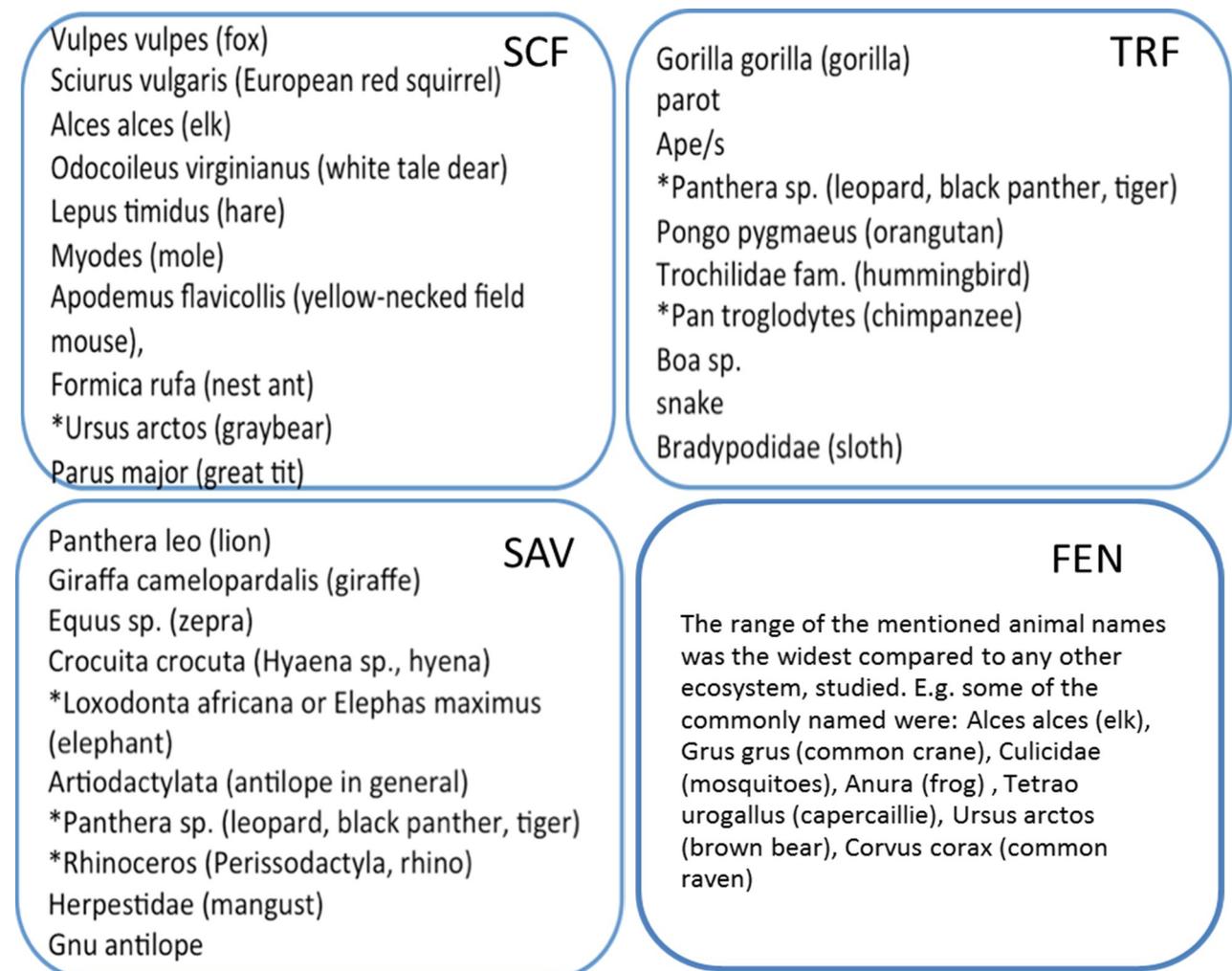


Figure 5. The most commonly named animals (species, genus, family or higher taxa) in the answers of pre service teachers (n=231). The results are shown per

ecosystem and in order of the most commonly named except for the animals in the fen

In the answers of ST students the most commonly named animal was also the lion in SAV like it was in the answers of PT students. Elk was the most common in SCF and crane in FEN. ST students favored most often gorilla and orangutan in TRF.

Where did the pre service teachers get their information from, did the asked information belong to basic knowledge and were the questions asked clear for them?

The majority of the PT students (65%) answered that the main source of animal information was school. The second source was home. Twenty of the PT students (11 %) and four of the ST students (8 %) answered that the hobbies were either the first or second important source for them. Three of the ST students wrote they had acquired their knowledge from the University studies.

85% of the PT students and 74% of ST students answered that the asked question belongs to basic knowledge (knowledge what the teachers need in their work). And 86% of the PT students and 67 % of ST students liked that the asked questions are clear for them. Couple of the ST students had commented that the concept of nesting is multifaceted.

Discussion

The nesting animal knowledge (ability to name animals) or nesting species knowledge (ability to name species) of the pre service teachers was researched with the reference to two northern ecosystems and two exotic ecosystems. Both primary school (PT) and subject teacher students (ST) were able to name mostly right animals to the right ecosystems. The consciousness of nesting animals of pre service teachers varied by students and by ecosystem. The pre service teachers had at least the very basic knowledge to teach animals according to the ecosystem except those few students who left empty answers in the questionnaire. The animals of the fen were most unknown but the range of the mentioned names among the pre service teachers was the widest compared to any other ecosystem. Only a few teacher students were able to mention the required number of 40 nesting animals. A higher number of the ST students reached this level compared to the PT students.

The fact behind this study was that the bigger is the number of named animals, animal species or animal groups the larger is the consciousness of the pre service teachers of the biodiversity. Two or three animal groups were found in most of the answers but 5-6 groups were seldom present. Mammals and birds were the most common ones, but usually the amphibians, fish and invertebrates were

missing. The same result got the Patrick and others (2013) when studied students' free listing animals. The place of the living organism is in relation to the matter how well people know them. The invertebrates especially insects are richest group of animals in species diversity as well as their density is high (Chinery, 1994). According to Spehardson (2002) people have negative images of them and that is why they are not known or they are so small that people do not see them (Lindemann-Matthies, 2005), although they are important e.g. from the point of view of food chain or other ecological functions. Our results show that the named groups by pre service teachers did not represent the real animal diversity in these ecosystems.

The ST students were able to name a bigger number of animal names (fig. 2), bigger percentage of groups with three or more animals (Fig.4) and more animals, especially birds (Fig. 3) at the species level. In the context that the most common entity used by conservationists is species (van Weelie & Wals, 2002), the ST students had a bigger biodiversity in their answers compared to the PT students. Dealing with species skills Balmford and others (2002) showed that the species identification increased with the age up to eight or nine years, where after the students' knowledge decreased. However, Huxham and others (2006) share the opinion that species knowledge skills increase within age. In this study the pre service teachers were not asked to identify animals, but part of the identification process is to name the animal. In this study the older ST students were able to name more animals than PT students, so this can support the finding of Huxham and others (2006). However, in this case the explanation is most probably the STstudents' biology studies and interests. Hobbies do not explain the difference, while very few of the students mentioned hobbies as an information source.

Our hypothesis was that by asking students to name nesting animals they would more likely name birds and other animals than mammals. The results were not in line with our hypothesis, while the most often mentioned animals were mammals. The most commonly named nesting animals were the same than in our earlier study (Yli-Panula & Matikainen 2011, 2013) where animals living or moving in the corresponding ecosystems were asked. ST students mentioned more nesting birds even at species level, so this may indicate that they are more aware of the taxonomy and also more conscious of the concept of nesting animals than PT students. As notice in earlier studies invertebrates were mentioned very seldom in comparison to the frequency how common they are in these ecosystems (compare to e.g. Snaddon, 2008).

The mean value of the named nesting animals was significantly higher in the answers of the ST students than the PT students. This was the case in the answers of all ecosystems dealing with both the animal and the species knowledge. The result is not unexpected while the ST students have had more biology studies and they are supposed to be more interested in biology, even in animals than the PT

students. Surprisingly the way they had acquired knowledge of animals was the same than the PT students used, mostly from school and home, very seldom from hobbies and even more seldom from University studies. Very few answers indicating the university studies (3 students) as a source can depend on matter that these were not listed to tick and some student teachers might have included them in the category school.

There are similar results concerning animal names in the study of Strommen (1995), who asked 6-year old children to draw forest and interviewed them about the living things in the forest. All the eight named nesting mammals (fox, squirrel, elk, deer, hare, mole, mouse, bear, Fig. 5) in spruce dominated coniferous forest, also elk (moose) and bear in the fen, and apes and tiger in the tropical rainforest and four mammals (lion, giraffe, zebra, tiger) in savannah were the same what the 6-year old children had mentioned. Other animals than mammals were parrot, frog, snake and ant. The simple explanation for this is that we learn the basic animal names in very early age and to learn plus remember the names needs continuous practicing. The animals named in the present study represent, e.g. the spectacular parrots, fearing predators like bear, lion, fox and tiger and popular squirrel, hare (rabbit) or unpopular predators wolf and snakes. These kinds of animals are easily remembered according to several researchers (Dalton, 2005; Prokop & Fancovicova, 2010; Prokop & Tunnicliffe, 2010; Rakison, 2009; Røskaft, 2003). They belong to the animals people have attitudes to, either positive or negative.

The animals were chosen as the study object since many previous studies have demonstrated that children are more interested in animals than e.g. in plants (Flannery, 1991; Hershey, 1996; Löwe, 1992); therefore, they would be more capable of naming animals than plants (Ryman, 1974; Lindemann-Matthies, 2002). Nearly all students and teacher students were able to mention at least 1–4 nesting animals in each ecosystem, and at least one student from each of the two groups of study subjects could name all the 10 animals in at least one ecosystem. This was also the matter in our earlier studies dealing the animals living in the ecosystems (Yli-Panula and Matikainen, 2011, 2013). In this earlier study (Yli-Panula and Matikainen, 2011) 84% of PT students were able to correctly name 8–10 animals in the SCF ecosystem. Animals seem to be the ideal study material as this subject matter can stimulate all students to answer to the questionnaire both in the case of the living or nesting animals.

To conclude, the studied Finnish pre service teachers have a basic animal and species knowledge (except for a few PT students) for teaching animals of different ecosystems and to understand the concept of biodiversity. For deeper understanding of biodiversity and it's concept more animal knowledge and species knowledge in connection to ecosystems is needed. Based on the entity of the nesting species, which was the original question, ST students are more prepared to conserve animal

diversity because they were more aware of nesting animal species. This investigation gives rise to future studies about the understanding and conceptualization of the pre service teachers of animals in connection to biodiversity.

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